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Fourteenth day of December 2004

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Patents Act 1990

PROVISIONAL SPECIFICATION

Applicant:

FLAMINGO HOLDINGS PTY LTD

Invention Title:

FASTENING SYSTEM AND METHOD

The invention is described in the following statement:

FASTENING SYSTEM AND METHOD

The present invention relates to a fastening system and method.

Fasteners for attachment of elongate elements, such as wires or electrical cables, to walls are known. One such fastener comprises a plastic member, adapted to be attached to a wall by a fixing member such as a screw or nail, which extends through part of the plastic member, in order to retain an electric cable between the plastic member and a wall. Typically, a large number of such fasteners are applied individually to secure a single elongate member. Accessibility of the fasteners, in use, may be problematic, and a user may hold a number of such fasteners in one of a number of ways: in his mouth - which is potentially dangerous; in a pocket - which may be inconvenient and may risk damage by the fixing member to a user's hand entering the pocket; or loose in a tool box - which may cause inconvenience and delay in accessing fasteners.

According to a first aspect of the present invention, there is provided a fastening system comprising:

a number of connected fasteners;

each fastener being suitable, in use, for retaining an elongate member; and

each fastener comprising:

a retaining surface defining a retaining channel for retaining an elongate member, the retaining channel having an axis; and

at least one leg member for contact with a surface relative to which an elongate member is to be retained;

wherein each fastener is attached to at least one other fastener by a connection element, which is adapted to allow a fastener to which it is attached to be manually disconnected from one or more other fasteners by breaking

the connection element or by disconnecting the connection element from at least one of the fasteners; and

wherein the fasteners are connected to each other so that, in use, a straight line which passes axially through the retaining channel of one fastener does not intersect any of the fasteners to which said one fastener is connected.

Preferably, each connection element is provided on or adjacent a part of the fastener which, in use, contacts the surface.

Preferably, the connection elements are formed with the fasteners by an injection moulding process.

Preferably, each connection element extends between two adjacent fasteners.

Alternatively, each connection element may connect a fastener to a member to which other connection elements are connected.

Preferably, each connection element comprises a frangible connection element portion.

One or more connection elements may comprise a number of connection element portions adapted to be simultaneously or sequentially broken or disconnected.

In one embodiment, each connection element comprises a strip of plastic. The strip of plastic may be generally rectangular in cross-section.

Preferably, a plurality of fasteners are connected in a line.

Preferably, a plurality of fasteners are connected in a substantially straight line.

Preferably, the line of fasteners is oriented substantially perpendicular to the axis of the retaining channel of each fastener.

Preferably, each line of connected fasteners comprises at least five fasteners.

Preferably, each line of connected fasteners comprises between six and twenty fasteners.

Preferably, each line of connected fasteners

comprises at least eight fasteners.

Preferably, each line of connected fasteners comprises approximately ten fasteners.

Preferably, each connection element is adapted to be broken or disconnected by relative twisting of two adjacent fasteners.

Preferably, each connection element is adapted to be at least partially broken or disconnected by applying torsion to the connection element.

Preferably, each connection element is adapted to be at least partially broken or disconnected by applying a tensile force to the connection element.

Preferably, each connection element is adapted to be broken or disconnected by relative twisting of two adjacent fasteners wherein at least part of the twisting action is substantially centred on the connection element.

Preferably, each connection element is adapted to be broken or disconnected by relative twisting of two adjacent fasteners wherein at least part of the twisting action is substantially centred on a point spaced apart from the connection element.

Preferably, at least part of the twisting action is centred on a point where abutment parts of the adjacent fasteners are brought into contact.

Preferably, each fastener includes at least one abutment portion for abutment with an abutment portion of an adjacent fastener to assist disconnection of the adjacent fasteners in use.

Preferably, at least one abutment portion on at least one fastener protrudes from the fastener.

Preferably, at least one abutment portion protrudes from a leg of the fastener.

Preferably, in a line of connected fasteners, each of the fasteners which are not at the ends of the line include at least two abutment portions, at least one of the said abutment portions being for abutment with at least one abutment portion of each of two adjacent

fasteners. The fasteners which are at the ends of the line may also include two abutment portions.

Preferably, at least one of the legs of at least one fastener includes a widened portion towards an end of the leg to slightly narrow an open side of the retaining channel. This can allow the fastener to be resiliently retained on an elongate member.

Preferably, a retaining surface on the retaining body is slightly convex in the direction of the axis of the retaining channel. Thus, the retaining surface may extend slightly further into the channel at the axially central part of the channel that at the axial ends of the channel.

Preferably, a retaining surface of at least one leg is slightly convex in the direction of the axis of the retaining channel. Thus, the retaining surface may extend slightly further into the channel at the axially central part of the channel that at the axial ends of the channel.

Preferably, the retaining surface on the retaining body includes a protruding portion for engagement with an elongate member.

Preferably, the protruding portion is aligned generally in the axial direction of the retaining channel.

Preferably, the protruding portion comprises a ridge which stands proud of the retaining surface.

Preferably, the ridge is slightly convex in the direction of the axis of the retaining channel.

Preferably, each fastener comprises a retaining body attached to the at least one leg.

Preferably, a surface of the retaining body and a surface of the at least one leg define at least part of the retaining channel.

Preferably, each fastener includes two legs with the retaining body extending between the two legs.

Preferably, a surface of each of the two legs and a surface of the retaining body define the retaining channel.

Preferably, at least one of the legs includes an engagement portion which, in use, engages a fixing member for fixing the fastener to a surface in relation to which the elongate member is to be retained.

Preferably, the engagement portion comprises a bore extending through at least part of the at least one leg.

According to a second aspect of the present invention, there is provided a fastening method for fastening an elongate member to a surface, the method comprising:

providing a number of fasteners which are connected together, each fastener providing a retaining channel, adapted, in use, to retain an elongate member therein;

placing a first fastener of said number of fasteners so that the elongate member is positioned at least partially in the retaining channel;

fixing the first fastener to the surface, to retain at least part of the elongate member relative to the surface; and

manually separating the first fastener from the other fastener(s).

Preferably, the method is performed in the order stated above,

Alternatively, the method may be performed in a different order.

In one embodiment, the first fastener may be separated from the other fastener(s) before being fixed to the surface.

Preferably, the method includes use of a fastening system in accordance with the first aspect of the invention.

According to a third aspect of the present invention, there is provided a fastener for retaining an elongate member relative to a surface, said fastener comprising:

a retaining surface defining a retaining channel for retaining an elongate member, the fastener including one or more projecting portions, which, in use, project towards the surface so that:

when used with an elongate member of a first larger predetermined cross-sectional size, said larger elongate member is held, with some deformation, against the surface by at least the projecting portion; and

when used with an elongate member of a second, smaller, predetermined cross-sectional size, said smaller elongate member is contacted by the projecting portion and held against the surface by the projecting portion without substantial deformation.

Preferably, the projection is provided on the retaining surface and extends therefrom.

Preferably, the projection is relatively hard compared to the outer surface of an elongate member and, in use, the deformation occurs mainly in the larger elongate member.

Alternatively, the projecting portion may be made of a relatively soft or resilient material and some or all of the deformation many occur in the projecting portion.

Preferably, the fastener includes at least one leg portion.

Preferably, the at least one leg portion has an end surface adapted to contact the surface.

Preferably, the at least one leg portion is adapted to space apart the projecting portion and the surface.

Preferably, the projecting portion comprises a ridge aligned substantially in the axial direction of the channel.

Preferably, the projecting portion is tapered so that it narrows as it extends away from the retaining surface.

Preferably, the fastener is adapted for use with insulated electrical cable.

Preferably, the fastener is adapted for use with insulated electrical cable in which a number of inner insulated cables are aligned side by side within an outer sheath, so that a single straight line can pass through the cross-sectional centres of each cable.

Preferably, the fastener is adapted for use with insulated electrical cable with two or three inner insulated cables and an outer sheath.

Preferably, the fastener is adapted for use with a larger cable having cross-sectional dimensions of about 12mm by 6mm.

Preferably, the fastener is adapted for use with a smaller cable having cross-sectional dimensions of approximately 9mm by 4mm.

Preferably, in use, the distance between the part of the projecting portion which is closest to the surface is approximately equal to the corresponding dimension of the smaller elongate member. In one embodiment, this dimension is approximately 4mm.

Preferably, in use with the larger elongate member, the projecting portion compresses a dimension of the larger elongate member, at the point of contact, approximately to the size of the corresponding dimension of the smaller elongate member.

Each fastener in accordance with the third aspect of the present invention may also form part of a fastening system according to a first aspect of the present invention.

Embodiments of a fastening system will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a side elevation of a preferred embodiment of a fastening system in accordance with an aspect of the present invention, in the form of a strip of fasteners;

Fig. 2 is a perspective view of the embodiment of Fig. 1;

Fig. 3 is a perspective view corresponding to Fig. 2 but including fixing members;

Fig. 4a is an enlargement of part of the view of Fig. 1;

Fig. 4b is an end view of the embodiment of Fig. 4a;

Fig. 4c is a cross-section corresponding to C-C of Fig. 4a;

Fig. 5 is a plan view from above corresponding generally to the part shown in Fig. 4a;

Fig. 6 is a plan view from below corresponding generally to the part shown in Fig. 5;

Fig. 7 is a perspective view corresponding to the parts shown in Fig.s 5 and 6, and showing fixing members in place;

Fig. 8 is a cross-section corresponding to 8-8 of Fig. 5;

Fig. 9 is a side view of a fastener, in use, and shows schematically the position of a first size of cable;

Fig. 10 is a side view of a fastener, in use, and shows schematically the position of a second size of cable;

Fig.s 11, 12 and 13 are cross-sectional views of parts of alternative embodiments;

Fig. 14 is a plan view of an alternative embodiment;

Fig. 15 is a schematic plan view of an embodiment similar to the embodiment of Fig.s 1 to 10, but with some elements proportioned slightly differently;

Fig. 16 is a schematic plan view of an alternative embodiment;

Fig. 17 is a schematic plan view of a further alternative embodiment; and

Fig. 18 is a cross-sectional view corresponding to 18-18 on Fig. 17.

With reference to Fig.s 1 to 8, a preferred embodiment of a fastening system comprises a plurality of

fasteners in the form of a strip of clips, generally designated 10. The strip of clips 10 comprises a number of fasteners in the form of generally n-shaped clips 20, the clips being attached to each other by attachment elements in the form of frangible attachment lugs 50.

Each clip 20 comprises a first leg in the form of a first, thicker limb 22 and a second leg in the form of a second narrower limb 24 which is approximately the same length as, generally parallel to, and spaced apart from, the first limb 22. A retaining body in the form of an intermediate portion 26 extends between the first and second limbs so that it connects respective first ends of the first and second limbs 22, 24 and is generally perpendicular to the first and second limbs 22, 24, to provide a generally n-shaped clip 20. Second ends 36, 38 of the first and second limbs 22, 24 are formed as coplanar flattened surfaces adapted to engage a surface with respect to which an elongate member is to be retained. Adjacent the second ends of the first and second limbs 22, 24 are inwardly flared portions 23, 25 to narrow the open side of the channel 32.

The first limb 22 includes a cylindrical bore 28 therethrough to receive a fixing member, which is illustrated in Fig.s 3 and 7 as a nail 30, although other fixing members such as screws could be provided. The bore 28 is provided with a countersink 29 at the first end of the first limb to accommodate a head of a fixing member. The first and second limbs 22, 24 and the intermediate portion 26 together define a retaining channel 32 which is defined by a retaining surface comprising a retaining surface portion 33 on the first limb 22, a retaining surface portion 34 of the second limb 24 and a retaining surface portion 35 of the intermediate portion 26.

As shown in Fig.s 9 and 10, the channel 32 of each clip 20 is adapted to retain (or at least to allow the clip 20 to retain) a cable relative to a surface. In particular, each clip 20 is adapted to be fixed to a

surface, such as a wall, by the associated nail 30 so that the second ends 36, 38 of both limbs 22, 24 contact the surface and so that a cable is retained in the channel 32 (since the retaining surface portions 33, 34, 35 define three sides of the channel 32 and the surface defines and closes the fourth side).

As shown in Fig.s 9 and 10, a preferred embodiment is adapted to retain either of two commonly used sizes of 3-core cable. Fig. 9 illustrates a clip 20, in use, with larger 13mm wide by 6mm thick cable 40 and Fig. 10 illustrates the clip 20, in use, with smaller 10mm wide by 4mm thick cable 42.

As best illustrated in Fig.s 4a and 4c, each of the retaining surface portions 33, 34, 35 is slightly convex in shape along the direction of an axis of the channel 32. That is to say each of the retaining surface portions 33, 34, 35 bulges slightly into the channel 32 so that the channel is slightly narrower at its axial centre than at its axial ends. This provides a smooth contact surface for contact with cable 40, which does not provide any sharp edges which might snag or gouge the cable. The retaining surface portion 35 of the intermediate portion 26 is also provided with a projection 44 in the form of a ridge which extends in the axial direction of the channel 32. This may provide an additional contact element for contacting and securing a cable once the clip 20 is attached to a surface.

The projection 44 and the distance between the projection 44 and the surface, in use, is arranged so that the projection 44 will contact and slightly deform the larger cable 40, firmly holding the larger 40 in place against a surface. However, when used with the smaller cable 42, the projection 44 will contact the smaller cable 42, in use, and therefore prevent undesirable movement of the smaller cable 42.

Thus, provision of the projection allows the illustrated clip to be used effectively with either size

of cable. In the illustrated embodiment, the projection 44 is tapered and is relatively small and hard, and when pressed onto the larger cable 40 causes deformation in the larger cable 40, and in particular in the outer sheath of the larger cable 40 (which is often easily deformable). In an alternative embodiment, the projection may be a pad of a resilient material so that deformation occurs in the projection rather than the cable.

Each of the clips 20 is connected to at least one other clip 20 in the strip by an associated attachment lug 50. The attachment lug 50 is adapted to retain the clips 20 in a strip during storage but to allow easy manual disconnection of the clips during use.

In the preferred embodiment, a clip may be disconnected from an adjacent clip by applying torsion to the attachment lug 50. That is, by twisting the clips relative to each other substantially about an axis which runs along the length of the strip of clips and which passes through the attachment lugs 50. In use, when a clip is attached to a surface and the remainder of the clips 20 in a strip are to be detached, the remainder of the strip will be held slightly away from the surface and the strip of clips will therefore not be straight. In this case, there will not, strictly speaking, be an axis which runs through both of the two clips 20 which are to be disconnected, and the application of torsion to the attachment lug may be considered as being applied by twisting the closest clip which is not attached to the surface about an axis which runs through that clip. It will be appreciated that the exact application of force may be varied in use and that as long as the connection elements are suitably frangible a frequent user will quickly learn to apply an effective direction and magnitude of disconnecting force by habit.

The strip of clips 10 is preferably moulded from a plastic material by injection moulding. It is desirable that the attachment lugs 50 should be sufficiently robust

to avoid frequent inadvertent disconnection of adjacent clips and it is possible that under some circumstances, a suitably robust attachment lug might not allow disconnection of the clips with a convenient relative rotation of adjacent clips. A preferred embodiment therefore includes one or more abutment elements on each of the adjacent clips so that during the disconnection operation, the abutment elements on adjacent clips contact each other to apply an additional force to the attachment lug. As best seen in Fig.s 5 and 6 in the illustrated embodiment, the abutment portions take the form of a first projecting ear 52 attached to the first limb 22 of a given clip and a second projecting ear 54 attached to the second limb 24 of an adjacent clip. It will be appreciated that when the clips are rotated by approximately 180° relative to each other, the first and second projecting ears 52, 54 will abut, and the point of abutment will form a pivot point about which the clips may be forced relative to each other. This allows a tensile force to be provided to the attachment lug 50 facilitating breaking of the lug and/or disconnection of the lug from one or other of the clips.

Each of the clips 20 has a first projecting ear at one axial end and a second projecting ear at a second axial end, with the possible exceptions of the clips 20 at either end of the strip (as manufactured) which do not require projecting ears at their distal ends.

It will be appreciated that in some embodiments, torsion may not be required and merely moving the strip substantially in the plane of the surface either directly away from the clip to be detached or pivotally about the attachment lug of the clip to be detached are viable by the user to break the attachment lug or to detach the attachment lug from one or both of the clips. Further, it will be appreciated that each clip may be attached to an adjacent clip by any suitable connection means which allows easy manual detachment and which is sufficiently robust to make inadvertent detachment of the clips a non-

existent or rare occurrence. Thus, it could be possible to attach the clips in a strip by means of adhesive pads, resilient (for example, metal wire) retaining clips or any other suitable means. However, it is considered particularly convenient and cost effective to provide connection elements which are integrally formed (for example, by plastics injection moulding) with the clips themselves.

In the embodiment of Fig.s 1 to 10, each attachment lug is in the form of a single, uniform, fairly flat, strip of plastic, moulded integrally with the adjacent clips. It will be appreciated that many other configurations are possible. For example, the attachment lug could be perforated to facilitate tearing, or could include a narrowed or weakened portion. Furthermore, each pair of clips could be connected by a plurality of elements extending therebetween so that manual detachment could consist of breaking the plurality of elements sequentially. The person skilled in the art will appreciate that many forms of frangible plastic connection are known per se and these, or other forms, could be incorporated.

In use, a user will offer up an elongate member to a surface in a desired position. For the purposes of this illustration, the surface is a surface of a wall but, of course, other applications are possible. The user will then place an end clip of a strip of clips so that the elongate member, such as a cable, is at least partially in the retaining channel 32 of the end clip 20. In most applications, it is preferred that the fixing member such as a nail 30 will be provided above the elongate member or cable, so that it is envisaged that the first thicker limb 22 will be placed above a generally horizontal cable and the second limb 24 of a clip will be placed below the generally horizontal cable. Thus, typically the clip 20 illustrated to the left of Fig.s 1 to 3 would be the first clip of the strip to be used, with the remainder of the

strip extending downwardly away from the cable. The user then attaches the clip to the surface by operation of the fixing member, in this example by forcing the nail 30 into the surface. The remainder of the strip of clips is then detached from the clip which is fixed to the wall, by breaking the attachment lug. In the preferred embodiment, this operation is performed by twisting the remainder of the strip of clips, relative to the clip which is attached to the wall, generally about the attachment lug. Engagement of the projecting ears may assist in breaking the attachment lug or detaching the attachment lug from one or other of the adjacent clips.

The process may then be repeated, as required, with the rest of the clips on the strip. It will be appreciated that unlike the use of clips which are not connected, a user can conveniently hold a considerable number of clips in one hand. In the preferred embodiment, a strip of clips includes ten such clips, but clearly the number of clips formed in a strip may be selected as desired.

It will be appreciated that many alternatives are possible. For example, each clip may be of a different shape to that illustrated in Fig.s 1 to 10.

Fig. 11 shows an alternative embodiment for use with an elongate member with generally circular cross-section.

Fig. 12 illustrates an embodiment in which the clip does not include two separate limbs of equal length.

Fig. 13 illustrates an embodiment in which a retaining channel 60 is provided by first and second resilient arms 62, 64 which may be forced around an elongate member which is to be fixed to a surface. This embodiment may be beneficial where contact between the elongate member and the surface is not desired, or where removal of the elongate member without removal of the clip from the surface is desired.

Fig. 14 illustrates three clips 120 of a number

of connected clips in which the three clips 120 are joined in a strip the axis of which is not parallel to the axis of each individual clip. The axis of the retaining channel is shown by a broken line designated "A" in Fig. 14 and the axis of the strip is illustrated by a broken line designated "B". It will be appreciated that like the embodiment of Fig.s 1 to 10, the channel axis A associated with any given clip 120 does not intersect with any of the other clips 120 in the strip. This allows each clip to be used to fasten an elongate member to a surface without interference of the remainder of the strip of clips with the elongate member. The broken line designated "C" in Fig. 14 illustrates that there is a degree of longitudinal overlap between a first projecting ear 152 of a given clip and a second projecting ear 154 of an adjacent clip. This helps to ensure effective engagement of the projecting ears 152, 154. It will be appreciated that the dimensions of the projecting ears shown in the embodiment of Fig.s 1 to 10 are somewhat schematic and, in practice, it would be preferable to have the projecting ears 52, 54 somewhat larger in order to facilitate effective engagement.

Fig. 15 illustrates schematically three clips 130 in a strip of clips similar to the strip of clips illustrated in Fig.s 1 to 10 in which the projecting ears 132, 134 have a greater degree of longitudinal overlap than those illustrated in Fig.s 1 to 10.

Fig. 16 illustrates an embodiment in which clips 140 are not arranged in a straight line but have a staggered configuration. Thus, the illustrated line of fasteners may be considered a staggered line. Each clip is connected to at least one adjacent clip by a respective attachment lug 150. Projecting ears 142, 144 are provided, which have a considerable degree of longitudinal overlap, facilitating their abutment.

Fig.s 17 and 18 illustrate an alternative embodiment in which clips 160 are each provided with a single attachment lug 162 but in which the attachment lug

of any given clip is not attached to an adjacent clip but is instead attached to an additional connection element which is connected to each of the attachment lugs 162. In such an embodiment, the additional connection element is preferably in the form of a longitudinally extending connection rod 164 which is formed in a single moulding with the clips in the strip. In this embodiment, detachment of a clip from the remainder of the strip is performed by rotation of the remainder of the strip and the connection rod 164 to break or disconnect the attachment lug 162 associated with the clip to be disconnected.

In the illustrated embodiment, the connection rod 164 is positioned so that it would be clear of an elongate element passing through a retaining channel (not shown) of the clip 160. However, a possible variation is to allow effectively automatic separation of a clip 160 from a connection rod by positioning the connection rod so that it would engage the elongate member when the clip is fixed to the surface and so that engagement would detach the clip 160 from the connection rod, for example by breaking the attachment lug.

It will be appreciated that in operation a surface of the rod 164 in the embodiment of Fig.s 17 and 18 will abut a surface of the clip 160 as the attachment lug 162 is deformed, and that continuing rotation of the rod 164 will apply a suitable force to break or disconnect a suitably structured attachment lug 162.

It will be appreciated that many other variations may be provided. For example, each fastener may be a fastener of the staple type that comprises a U-shaped length of metal having sharpened ends. In this case, the inner surface of the curve of the U may be regarded as defining the retaining channel (which, in such a case, is clearly axially short). A number of such staple like fasteners could be attached together, for example to form a line of fasteners aligned perpendicular to the axis of

the retaining channel of each fastener and in which the sharpened ends of the fasteners form substantially a single line. The skilled person will appreciate that there are many possible ways of connecting such fasteners in this way while still allowing easy manual detachment of each fastener from the others.

Although the embodiments of Fig.s 11 to 18 are described and illustrated to show envisaged alternatives, the embodiment of Fig.s 1 to 10 is preferred. Although the attachment lugs may be provided at any desired and convenient point on each clip, it is preferred that they are provided so that, in use, once a clip is detached, any attachment lug or part of an attachment lug still attached to the clip will be close to the surface to which the clip is attached. This helps to avoid unsightly and possibly hazardous broken plastic elements remaining on the clip where they are likely to be contacted by other objects.

In the claim which follows and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or in any other country.

Modifications and improvements may be incorporated without departing from the scope of the present invention.

Variations and modifications can be made in respect of the invention described above, and an aspect of which is defined in the following statement of claim:

1. A number of connected fasteners;

each fastener being suitable, in use, for retaining an elongate member; and

each fastener comprising:

a retaining surface defining a retaining channel for retaining an elongate member, the retaining channel having an axis; and

at least one leg member for contact with a surface relative to which an elongate member is to be retained;

wherein each fastener is attached to at least one other fastener by a connection element, which is adapted to allow a fastener to which it is attached, to be manually disconnected from one or more other fasteners by breaking the connection element or by disconnecting the connection element from at least one of the fasteners; and

wherein the fasteners are connected to each other so that, in use, a straight line which passes axially through the retaining channel of one fastener does not intersect any of the fasteners to which said one fastener is connected.

Dated this 25th day of November 2003

FLAMINGO HOLDINGS PTY LTD

By their Patent Attorneys

GRIFFITH HACK

Fellows Institute of Patent and

Trade Mark Attorneys of Australia

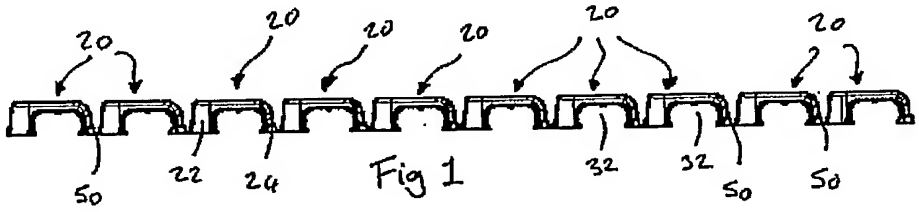

Fig 1

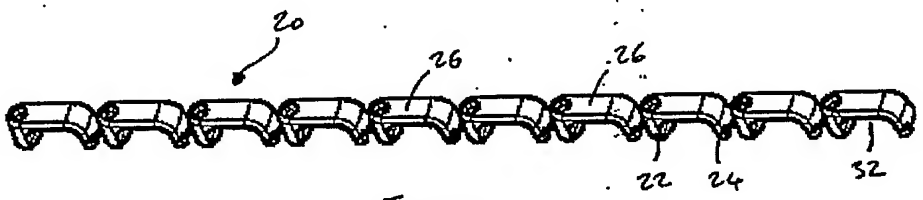

Fig. 2

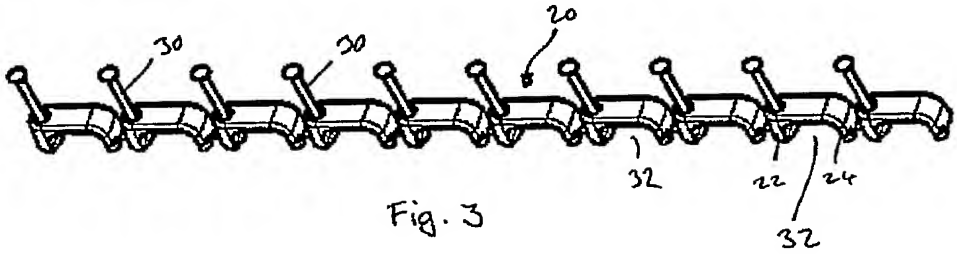

Fig. 3

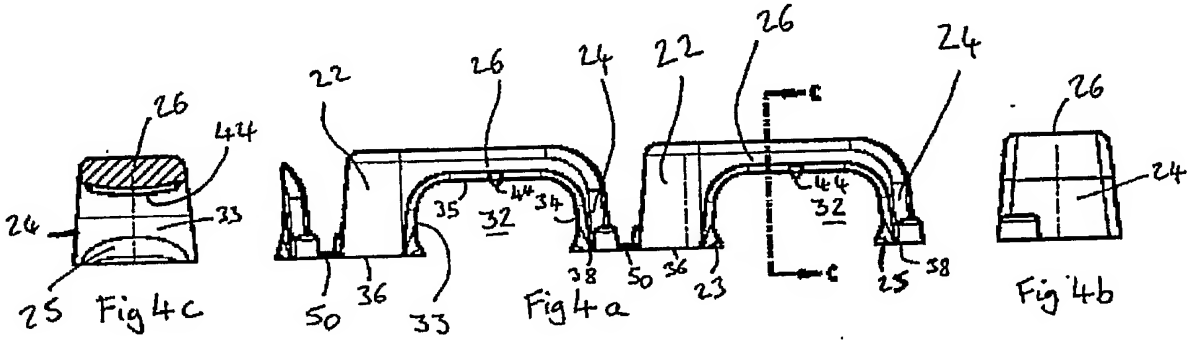

Fig 4c Fig 4a Fig 4b

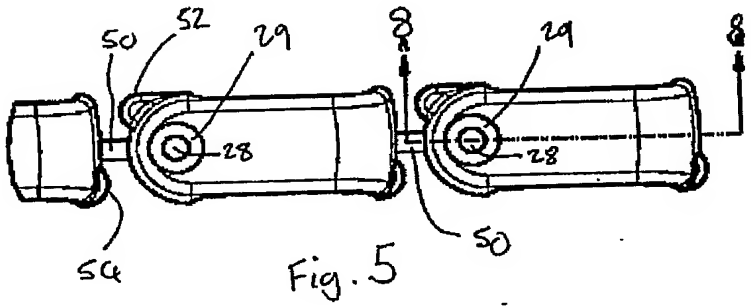

Fig. 5

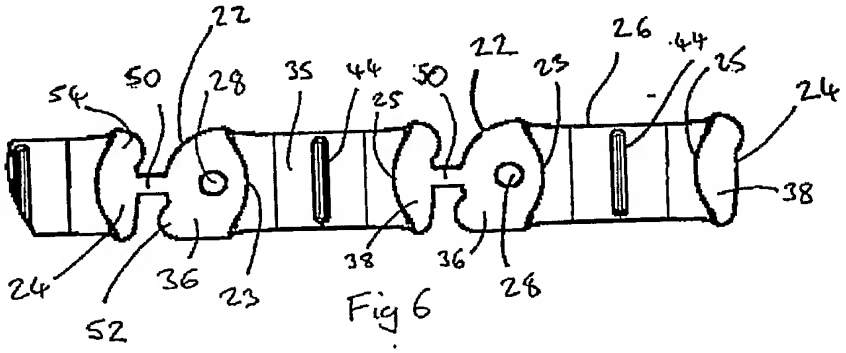

Fig 6

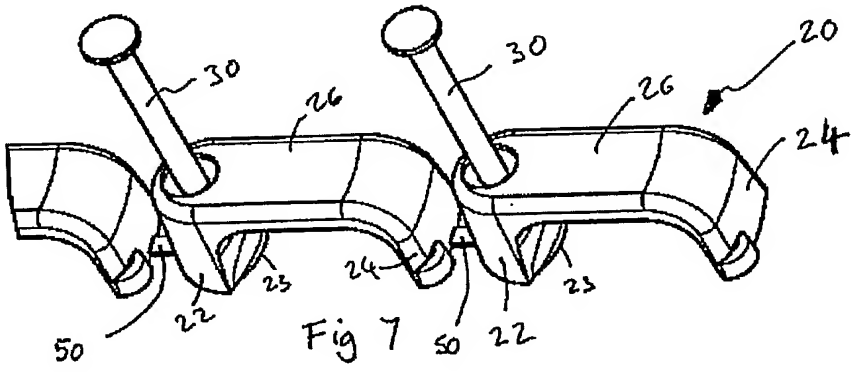

Fig 7

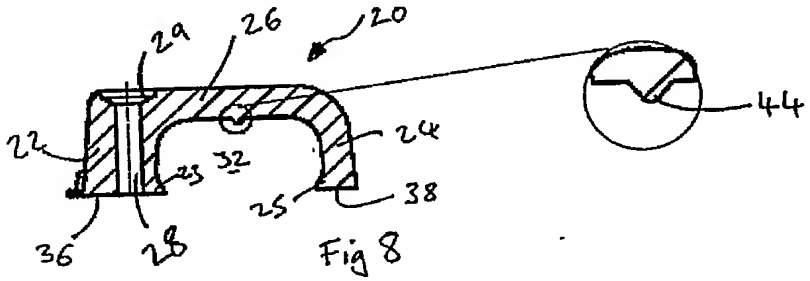

Fig 8

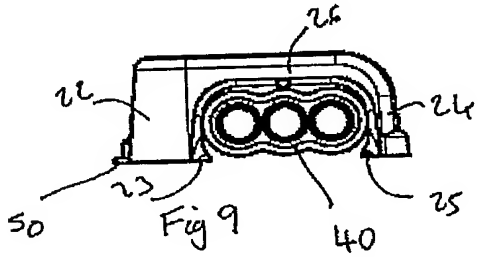

Fig 9

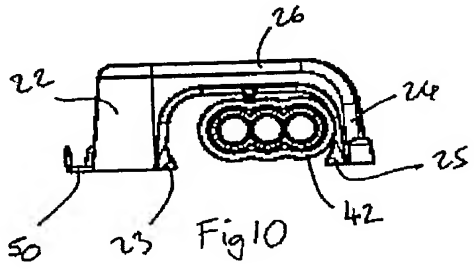

Fig 10

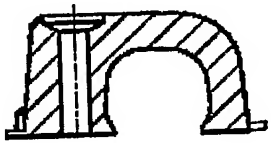

Fig 11

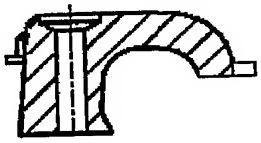

Fig 12

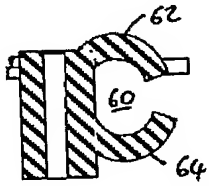

Fig 13

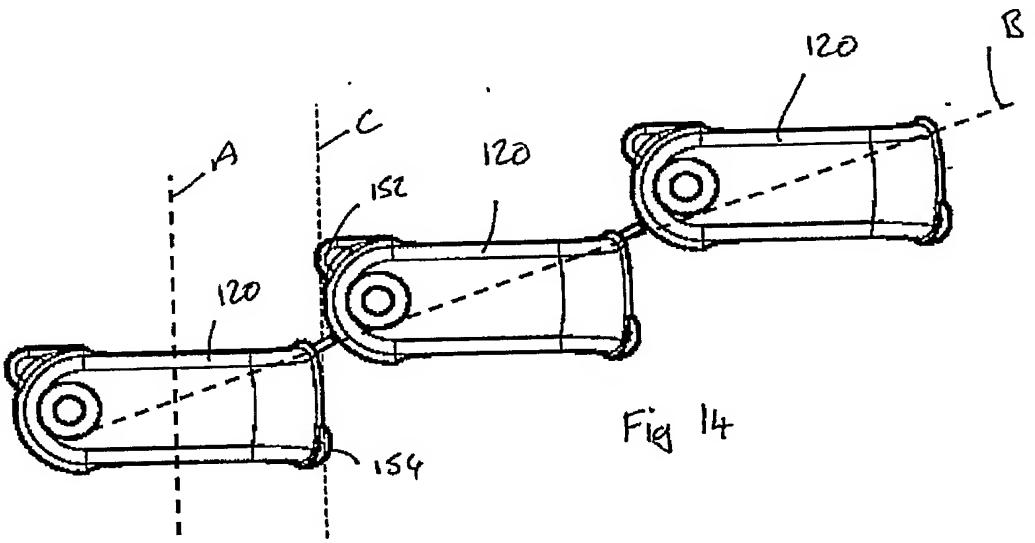

Fig 14

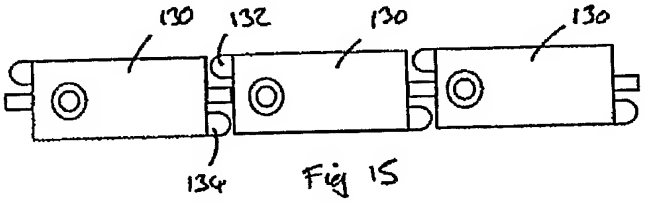

Fig 15

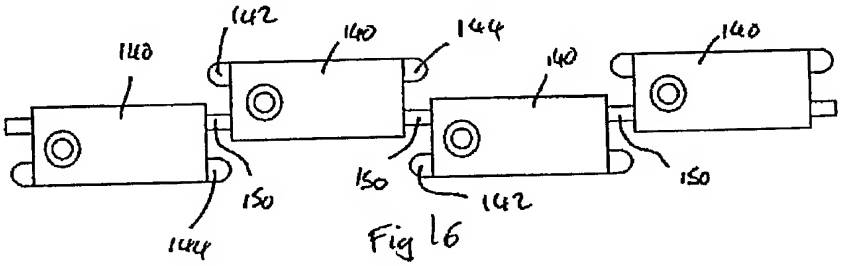

Fig 16

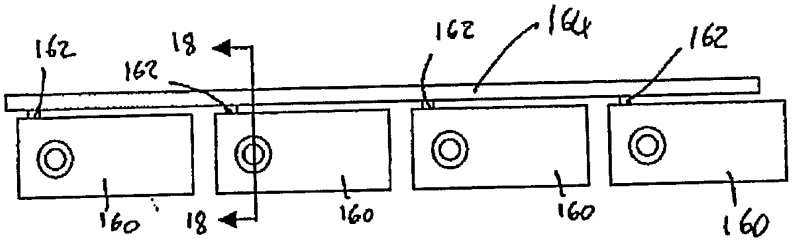

Fig 17

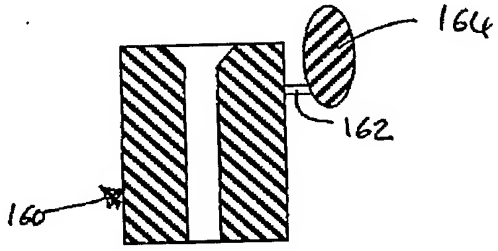

Fig 18